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August, 1957

The Air Line Pilot

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"Briefcase Brains" Or Judgment?

Pilots Will Never Lack A Fat Briefcase Of Manuals. But Are "Briefcase Brains" And Rote Instead Of Reason A Valid Substitute For Judgment Dictated By The Situation?

By Capt. F. E. W. Smith
Canadian Air Line Pilots Assn.

Among the few sure things in this world of uncertainty is that no air line pilot will ever suffer for want of regulations and directions to tell him how to do his job. We are — most definitely — instructed and informed. Whether the weight of the "briefcase brains," which all pilots religiously carry to their aircraft and stow in a handy spot, has ever been accurately determined or not is not known by the writer, but a good guess would be twenty-five pounds plus for the average run and competency.

The battered and bulging briefcase is an interesting object. The trademark of a pilot, it is as much a part of him as the doctor's bag is of the medical man. It contains all the tools, except perhaps a pencil and a computer, that a pilot needs in order to take an airplane anywhere. Everything is in it — maps for the routes, route charts of facilities, airport charts of safe, company devised instrument procedures for all terminals and alternates, radio frequencies, aircraft operating manuals which tell the pilot all he needs to know about his airplane, government regulations to control the airways, company regulations which tell him when he can drink in addition to how to flight plan, what his authority is, whom he shall carry, the weather he can fly in and, perhaps, even a copy of *Playboy* or a small boat manual as extra-curricular equipment.

Constant Revisions

An interesting feature about this weight of printed matter is that it is constantly being revised. No pilot can open his mail box after a few days off without finding it stuffed with a thick sheaf of changes to various manuals. Another interesting point is that only a genius could be fully conversant with this rapidly changing library without spending a great deal of time in constant study. Yet if there is trouble of any sort, it is presumed that the pilot knows his manuals down to the finest print and the smallest restriction. This may seem unfair but it is necessary it be so. The pilot's responsibility for knowing his briefcase is one of the tribulations of the profession.

All transportation companies bear heavy public responsibility because they are entrusted with the lives of their customers. And all such businesses are compelled to transfer the major weight of this responsibility to the shoulders of their operating personnel. Most of the time the company executives have no control whatsoever over the actions of their crews. How can they effect the direction which they must have if they are to provide the public with safe transportation? Firstly, they make sure that the operators, the men who actually do the job, are properly responsible and co-operative. Secondly, they instruct them carefully as to how they wish things done — this they do in the form of regulations. The pilot's briefcase, repository of the air line's information and instruction, is a very important file.

Familiarity Needed

It would follow logically that the best way for a pilot to find air line success is to know his briefcase thoroughly and follow its dictates to the letter. Many pilots operate in accordance with this principle. But many others regard the company's instructions, and in some instances even the government's rules, as of advisory strength only and sometimes elect to disregard that which has been prescribed. The air lines do not seem to regard such pilots with disfavor — in fact, they often seem to cherish them.

There is good reason why an air line should respect such a man and herein is good thought food for pilots who are presumed more interested in getting to pension age than they are in making any particular supervisor happy. It is quite important to stay alive, and if this is done, the air line will be happy enough.

This series has repeatedly pointed out that the air is a very large ocean — stormy and untrustworthy — which can and does throw sneaky curves at pilots from time to time. Being so variable, and having so many mechanical and weather tricks up its sleeve, it is quite impossible for the air line executive to write regulations which will fully cover every situation. And it has been shown in the past that even some of those which are provided can be, in certain circumstances, quite the wrong prescription. An air line would far rather have a pilot who is capable of

Vol.26, No. 8

The Air Line Pilot

August, 1957

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Published Monthly by the Air Line Pilots Association, International, Affiliated with A. F of L.-C.I.O. Publication offices: 55th Street and Cicero Avenue, Chicago, 38, Illinois.

Advertising appearing in this magazine cannot be construed as being an endorsement by the Air Line Pilots Association or The Air Line Pilot.

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Annual Subscription, $2.50

thinking through any given situation than one who is merely able to carry out instructions with machinelike precision. The most unpopular mishap is one which has occurred because the regulations were followed.

Reasons Noted

Men who follow rules steadfastly do so for differing reasons. Concept of the proper way to serve is perhaps the most common, fear of criticism is another, meekness ("Who am I to presume I know more than the boss?") is a third. But whatever the motive, rules which are followed because they are rules are not usually thought through. The man has not considered the wisdom of the instruction, decided he is in agreement, and thereupon has made it his rule. He doesn't have rules of his own — just the company ones. Years of placid, calm operation have not convinced the writer that the air is a safe place in which to work. It isn't, and if a man works in a dangerous place there is only one safety for him. That is a full understanding of the risks involved coupled with a reasoned motive for every action taken. The pilot is entitled to ask "why" to every rule and procedure, and to reject "It's in the book" as an answer. Following a rule because it is a rule, without thinking it through and agreeing with it, is not, in this opinion, the way to a safe operation.

If a pilot decides to sacrifice his right to understand, and proposes to fly by the book, his good judgment does not develop. He has traded understanding for authority. The situations he meets on his trips, whether in the air or on the ground, he settles in accordance with the printed instruction, not from any conviction of his own as to the best method. What happens when there is no instruction covering the situation? Almost invariably there is no judgment available to make the necessary decision; almost always the other pilots are shocked to hear him ask for someone to tell him what to do. He doesn't particularly care who tells him what to do, just so long as someone will act with authority and decision.

Right To Disagree

The pilot who considers the rules as advisory, reserves the right within himself to disagree with the instructions he is supposed to follow and to proceed on a course of action of his own. While he may be exhibiting an irresponsible attitude, he is not necessarily doing so. More likely he realizes his actions must be based on reason and not on rote. This compels him to examine all instructions critically, not only for their value, but also in accordance with the circumstances and his own abilities. He will at times modify them for better advantage. When faced with a situation not covered in the book he is willing and prepared to think out a solution, judge it, and operate as it dictates. His powers of judgment and his self-confidence build with each incident. He becomes increasingly valuable to his air line because he is a Captain — a man of judgment and responsibility who is able to command.

The pilot who operates in accordance with rules of his own, which are based on and closely parallel to those laid down for him, seldom suffers criticism for his individuality, provided he exhibits good overall common sense in his operation. However, occasionally there is a pilot who breaks rules indiscriminately through some sort of basic irresponsibility or childishness. He is a fool, a menace, a dangerous man. His actions are not based on good reason and sound judgment but on some obscure motives of his own. They are not likely to equal the careful and considered instructions which experienced managers have laid down in the manuals.

The opinions of this article do not intend a lack of respect for the manuals in the briefcase. These are prepared by capable, experienced men to direct pilots on how the air line wishes its aircraft flown, to provide them with safe procedures, to give them all the information and advice possible on many details of flying. The most inventive pilot would be hard pressed to improve their contents appreciably — there is no reason for not "going by the book" most of the time.

Initiative Needed

The objection here is in blanket acceptance of the books and blind obedience to what is contained therein. There is a point here relating to the subject matter of this series. It is felt that a properly descriminative attitude toward the contents of the briefcase is quite important to the full development of a professional air line pilot. The airman is required by circumstance to be a thinking man, prepared and able to calculate risks and decide on suitable actions. The rules can become overpowering. Too great respect for them inhibits the thinking initiative of the pilot, turns him into a human automatic pilot who substitutes a manual for his personal judgment.

(Continued on Page 17)

On The Cover

Among possible DC-3 replacements being considered by U. S. local service carriers, is the British Handley Page "Herald," a four-motored, pressurized, high-wing aircraft. Specifically designed for local services and operation in undeveloped regions, the "Herald" has been ordered by several foreign carriers for service on short or medium haul routes. According to the manufacturer, it can operate, with full payload, from 1,000-yard grass strips in tropical highlands.

The "Herald" carries passengers or freight or a combination of both, seating 36 passengers in first-class configuration and 44 in tourist class. As a freighter, the aircraft can carry a maximum load of nearly five tons. Its cruising speed is in excess of 200 mph.

Performance of each of the four Alvis Leonides Major piston engines is set at 866 B.H.P. for take-off at sea level.

The "Herald's" overall length is 70 feet 3 inches and maximum diameter 9 feet 2 inches. The aircraft's overall height is 22 feet 4 inches and its wing span 94 feet 9½ inches. Maximum take-off and landing weights are 37,500 lbs.

Hazards Of The Mountain Wave

Atmospheric Research Has Advanced Some Ideas As To The Possible Causes Of Accidents In Mountainous Terrain While Flying In Instrument Weather

By J. Kuettner and C F. Jenkins

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(From Air Force Surveys In Geophysics, *No. 35)*

In the past, some very experienced pilots and crews have been lost in air accidents due to unexplained circumstances. These mishaps apparently occurred for no reason other than miscalculated positions, with subsequent flight directly into the mountains while on IFR. In some cases these occurrences were almost unbelievable, considering the vast flying experience possessed by the crews involved. How could they have happened? All too often, after a thorough investigation had been made, the inevitable answer was: Pilot Error.

Atmospheric research has advanced some ideas as to the possible causes of such accidents. In fact, quite a few of the accidents which have been attributed to pilot error, for lack of any other obvious cause, might have been prevented had the pilots been properly informed of the hazards in flying a strong mountain wave. A mountain wave is a disturbance of the atmosphere set up by mountain barriers and characterized by a wave-like airflow in which severe turbulence, vertical currents, and altimeter errors combine to form dangerous flight conditions.

Preliminary results of the "Mountain Wave Project" confirm that the conventional conception of the wind flow pattern over mountain ranges is in error. This is particularly true when a strong flow exists perpendicular to the ridge lines, as required for the formation of a mountain wave.

It is intended that this survey provide pilots with a more complete picture of the wave and with a detailed description of its structure. Additional meteorological information on the subject is contained in Air Force Surveys In Geophysics No. 15, "Forecasting the Mountain Wave," September 1952.

Let us first accompany a pilot as he attempts to traverse a strong mountain wave without sufficient knowledge of its characteristics. A great deal of flight experience in the study of such waves has been incorporated here in an attempt to give pilot readers a feeling of what they might encounter were they unaware of the experiences to be expected. Later in this report the wave phenomenon will be explained as to its formation and features.

Encountering A Mountain Wave

Let us suppose you are fighting strong head winds at 10,000 ft. altitude in a moderate-speed aircraft. Two hundred miles ahead on your flight course is X-Mountain. It may be one of the Rocky Mountain ranges when you are heading west; it may be the Alps when you are heading south, or it may be just a small, little-known ridge.

There are not many clouds around and visibility is very good. The air is smooth up here although in the lower layers it is quite turbulent. You are flying with a slight drift correction. Some time ago you spotted a long white cirrus band over the horizon far ahead. At about 100 miles from X-Mountain you notice that this cloud bank seems to extend just along the mountain range although at a much higher level than the peaks of the range. Apparently it does not move despite strong upper winds. The summits of X-Mountain cannot be seen. They are covered by a flat white cloud blanket.

Every minute you can see more details. The high cirrus cloud ahead consists of a few parallel banks extending from right to left, normal to the wind. As you approach this cloud it does not look as white and harmless as it looked from 200 miles away. There are dark, dense parts in it and you would not dare to guess how high it is. You would not even call it a cirrus cloud any more. It looks more like a big altocumulus cloud. You can see that this cloud is composed of a number of layers staggered vertically like pancakes. The leading (upwind) edge appears quite sharp and seems to follow every bend in the long mountain range.

Farther upwind blue sky extends over the flat cloud blanket ("cap cloud") which covers the mountain tops. The high cloud extends only downwind of the mountain range. It is a so-called "lee cloud."

You are now 50 miles from X-Mountain. Climbing slowly you should be able to pass below the high altocumulus cloud and then above the cap cloud and X-Mountain. There is a wide gap of blue sky between these two cloud layers, and except for some long lines of cumulus clouds under the high cloud bank, you do not expect any clouds at all on your flight path and head directly into this gap.

Two Apparent Lines

Apparently there are two of these cumulus lines extending from right to left just this side of the mountain range. They look so harmless that you really do not worry about penetrating them. The row nearer you consists only of some broken ragged cloud pieces ("fracto-cumulus"). They seem to be just about as high as the mountain tops and the cap cloud. The cloud line nearer the mountain range looks much more dense and builds up higher than the cap cloud over the mountains, although it is certainly not comparable in depth to the big shower clouds you had to penetrate sometimes. None of the cumulus clouds here give any indication of precipitation.

As you cannot estimate how much space exists between X-Mountain and the cumulus lines you have to decide now if you want to pass beneath, above, or through the cumulus clouds. Had you heard about the "Mountain Wave" earlier you would have made up your mind a long time ago. You would know by now that the harmless cloud picture ahead displays all indications of impending danger. Now you have to learn it the hard way!

You decide to continue your flight towards the cloud gap by climbing steadily. You will probably pass through the first tiny cumulus line which is now only a few miles ahead. Fixing your eyes on some of the cloud fragments you notice that they show strong rolling motion. You remember having heard of a "*roll cloud*" and anticipate some turbulence.

Upon contact with the first cloud pieces, your ship banks steeply and you are thrown against the ceiling of your cockpit. You have your hands full to regain control of the plane and you do not find time to watch your altimeter or rate of climb indicator. Nevertheless, you feel that the ship is climbing and descending rapidly in what you would call severe turbulence. This dance lasts only one or two minutes then suddenly the air is smooth again and you have a good rate of climb. You have passed the first roll cloud and have time now to fasten your shoulder straps and to think your situation over. Looking upwards you notice that the high cloud is now huge and compact, completely shading the countryside. Your decision to climb *over* the cumulus lines seems justified by your first experience.

The rate of climb is unusually good after passing the first roll cloud. You can already see over the next cloudline, which seems to be 5 to 10 miles ahead, and you should have plenty of height to clear even the highest cloud tops of this roll cloud. With the air quite smooth you are confident that you are out of trouble by now. Looking down at the valley floor you notice that jet-like dust streaks indicate strong surface winds. Your progress is slow. Apparently the upper winds are very strong. As a consequence you have to change your drift correction to stay on course.

Now you are high enough to look down on the next roll cloud. The cap cloud over X-Mountain ahead is snow-white in the brilliant sun. It seems to pour down the mountain slope like a cloud waterfall. Farther upwind the cap cloud merges with the horizon and it is hard to estimate whether you are higher than this cloud layer or not. The huge altocumulus cloud above is even darker now. The leading (upwind) edges of the different pancake layers are staggered toward the wind. The highest one is still far ahead and shows a brilliant white rim. Now you can see the profiles of the staggered layers. They are lens-shaped and you remember having heard meterologists say that so-called "lenticular clouds" occur frequently over mountains.

Unexpected Experience

Something unexpected must have happened suddenly. The roll cloud ahead has started to build up quickly in front of you. Looking downwards you notice that the plane does not seem to be making any headway. Now the first cloud drifts by under the plane. If the cumuli continue to rise that way you are not sure that you can make it.

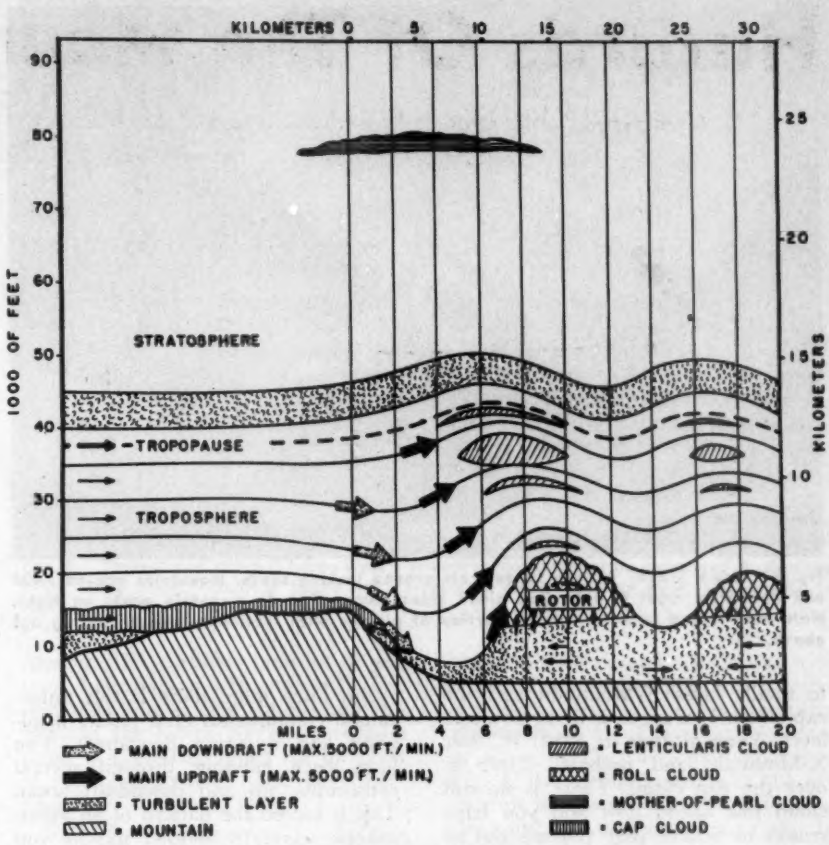


Fig. 1. A cross section of a mountain wave.

A glance at the rate of climb indicator reveals what is going on: the ship is falling at over 2,000 ft./min. in completely smooth air. What you need now is ground speed. With the nose down and full power, clouds seem to shoot by underneath the plane but the ground still does not show noticeable movement. The rate of descent is now 2,500 ft./min. A big cumulus turrent builds up ahead and engulfs the plane within seconds. You have fallen from above into the roll cloud.

What follows is no longer controlled instrument flight. Heavy gusts make all the instruments dance. The speed drops down, then shoots up, the rpm's are changing rapidly and the engine is howling. Several times you hang in your belt without the slightest idea of attitude. You have not encountered anything like this before. You recall a thunderstorm flight which scared you to death but the turbulence was nowhere near this bad.

Suddenly you drop out of the cloud base and the view excites you: everything seems to have changed. X-Mountain looks down on you like a big barrier, the clouds sweeping down its slopes with visible speed and dissipating just in front of you. You are about ready to turn back when your plane is lifted with enormous power. In heavy vertical gusts your rate of climb jumps to 1,000 ft./min., later to 2,000 ft./min. The leading edge of the cumulus line is now just above you. To avoid being pulled back into the roll cloud you push the nose down. Apparently you now have a good ground speed and the ship is climbing fast just in front of the cloud line which looks like a long railroad train. Suddenly the gusts die out. The air becomes smooth as glass. But your rate of climb is now 2,500 ft./min. You are stunned by the fact that such extreme degrees of smoothness and turbulence can coexist so closely in the atmosphere. Looking back after a few minutes you notice that you are already higher than the top of the cumulus line. That should be enough

Fig. 2. "Ideal wave" picture taken from ground looking south. Mountains are on right and flow from right to left. Cap cloud hides Sierra Nevada mountain peaks on right. Note rotor cloud in lower center portion of picture with lenticular clouds fanning out above.

to finally cross X-Mountain and the cap cloud. You are now flying at a safe level. Your altitude is 3,000 ft. over X-Mountain and probably 2,000 ft. over the cap cloud. There is no roll cloud line ahead now and you have reason to believe that you are out of trouble.

A Fascinating Spectacle

The foot of X-Mountain lies just below you. The trailing edge of the cap cloud is only one mile ahead. The cloud mass pouring down the mountain slope and dissipating is a fascinating spectacle. The upwind edge of the high lenticular cloud is directly overhead, maybe between 30,000 and 40,000 ft.

The ship makes good headway now but the updraft is slowly tapering off and you have to use more power to keep altitude and ground speed.

High as you are above the low-level clouds you feel almost—but not quite—safe. This completely smooth air has proved treacherous before and you are not sure what it has in store for you this time. The crestline of the mountain is not yet passed and ground speed seems to drop again. After another minute the low clouds look nearer. There has been no indication of what your altimeter and rate of climb now reveal: you are falling again at 1,000 ft./min., and full throttle does not help. You feel if you can go another mile upwind you should be through.

But once more there is this unfortunate combination of a jetlike headwind and a strong downdraft. You have been running through several consecutive up and downdraft areas. This is indeed the pattern of an atmospheric wave. In another minute you will know if you can pass X-Mountain. The cloud waterfall is directly beneath the plane now. But in front of you the cap cloud climbs fast. The air is still quite smooth, but now you are falling at about 3,000 ft./min. Three thousand feet per minute? That means you will crash into the mountain within another minute. What does your altimeter show? A thousand feet above the highest peak of X-Mountain. But now you can see a mountain peak through the cap cloud. That is certainly not 1,000 ft. below you. It is just about your present height. Is the altimeter wrong? Only a quick decision will save you. Turn back.

While you bank in a steep left turn the air becomes hazy. A glance at the instrument panel and the mountains shows that you are falling at almost 4,000 ft./min. into the lower end of the cloud waterfall. Suddenly a terrific gust banks the airplane into a steep right turn towards the mountain. For a moment you see the rocks of the mountain rapidly coming nearer. Then you succeed in maneuvering the plane away from the stone wall.

In The Cloud Waterfall

You are right in the foot of the cloud waterfall which looked so smooth from above and the airplane shoots with an enormous tailwind 1,500 ft. over the valley floor. As the heavy gusts diminish you look back on the towering mountain range and the cap cloud which only a few minutes ago lay under your feet.

In a matter of minutes you have passed under the two roll clouds and the nightmare is over. You decide to do what you should have done in the first place: change your flight course, fly around X-Mountain and avoid traversing a full-scale "Mountain Wave."

The foregoing probably describes a typical mountain wave experience. In this case, the pilot encountered a very powerful wave, but with the favorable factor of good visibility which enabled him to recognize cloud types and thus orient himself and maneuver the ship out of immediate danger. It is conceivable that the situation would have been more serious if the wave were very dry, with no clouds to give any indication of hidden danger; or on the other hand, if the mountain were completely obscured by a massive cloud layer.

Disastrous Flights

There have been a number of disastrous flights made under conditions similar to the one described above. An example is that of the DC-3, "Saint Kevin," which ran into a mountain wave while in instrument flight over England on January 10, 1952. The mountain involved (Snowden) was only 3,500 ft. high, which indicates that mountain waves are not restricted to the higher peaks. The following is quoted from a report by A. H. Yates (College of Aeronautics) in *Flight*, January 2, 1953. The reader will recognize some of the features just described.

"Early in the morning a jetstream at 30,000 ft. was blowing at about 150 knots from WNW, but abated during the day. By evening the wind at 30,000 ft. was still about 100 knots and reached 60 knots at 5,000 ft. . . .

"The Saint Kevin left Northold at 1725 GMT for Dublin and, after flying along the Airway to Daventry, turned into the 60 knot headwinds on course for Dublin. The course should have carried it some 15 miles south of Snowden to reach the coast at the Nevin radio beacon but, owing to the unexplained errors in navigation, the aircraft followed a track which took it directly towards Snowden. An error in

estimating ground speed was also made with the result that the captain thought he was progressing faster than he was. . . .

"At 1854, when a reconstruction of the flight suggests that he had just reached the first Welsh hills, west of Oswestry, he sought and received permission to climb from his quadrantal height of 4,500 ft. to the next one at 6,500 ft. No reason was given, but the fact that the request came on his arrival over the first hills suggests that rough air was the cause. After flying at 6,500 ft. for about 10 minutes the captain reported, erroneously, that he had reached the sea and requested a descent clearance (presumably to 4,500 ft. again, the lowest height permitted over the sea). . . .

"The last message indicated that the captain began to let down from 6,500 ft. in the belief that he was over the Irish Sea. In fact, he was about ten miles downwind of Snowden in meteorological conditions favoring the setting up of powerful lee waves. The lower quadrantal height of 4,500 ft. clears Snowden by less than 1,000 ft. and, if reaching this height was coincident with a severe downcurrent from the lee wave, the Saint Kevin may easily have been drawn into the eddy system associated with the mountain. The pilots, thinking that they were now over the sea, would not be expecting violent turbulence; and it appears that they lost control of the aircraft which then shed part of a wing just before diving into the ground 1,200 ft. above sea level. . . .

"The report of the public inquiry into the causes has been published, and the findings give the probable cause of the crash as 'the encountering of a powerful down current of air on the lee side of Snowden which forced the aircraft down into an area of very great turbulence'. . . ."

The Mountain Wave Project

To investigate this type of airflow, the "Mountain Wave Project" was implemented under the joint sponsorship of the Geophysics Research Directorate of the AF Cambridge Research Center and the Office of Naval Research. It was conducted by the University of California in cooperation with the Southern California Soaring Association and several government and private organizations. (These included the U. S. Weather Bureau, the Air Weather Service, the Naval Ordnance Test Station at Inyokern, the Hastings Instrument Company, the Symons Flying Service, the Institute of Numerical Analysis, the Air Force Lookout Mountain Laboratory, and others.) The field tests were carried out during 1951-1952 in the Sierra Nevada mountain range in California under the direction of the Geophysics Research Directorate.

Fig. 3. Typical cap cloud ("foehn wall") sweeping down mountain slope and dissipating over valley floor. Mountain peaks are completely covered. Wind flow is from left to right.

Specially instrumented sailplanes were used to trace the streamlines and the temperature and pressure field in the neighborhood of the mountain range when a strong flow existed perpendicular, or nearly perpendicular, to the ridge lines. Conditions were investigated up to a record height of 44,500 ft. by use of these sailplanes which were tracked by radar, Raydist and cine-theodolites. Time-lapse cameras took motion pictures of the associated cloud structures from the ground to supplement the data taken by the sailplanes. Meterological stations were established on both sides of the mountain range from the valley floor up to an elevation of 9,000 ft.

Gliders were preferred to powered planes or balloons in this project because of their small sinking rate, low speed, maneuverability, and accuracy of calibration. They can remain aloft for many hours traversing the wave using updraft areas to gain altitude and, due to their low speeds, can be used to investigate the structure of severe turbulence which higher-speed, conventional aircraft try to avoid.

Airflow And Clouds In The Wave

Figure 1 is a cross section depicting the conditions generally associated with a typical mountain wave, which meteorologists often refer to as the foehn phenomenon; *Fig. 2* is an actual photograph of such a wave. As indicated in *Fig. 1*, the mountain range at the left extends to about 14,000 ft. MSL and the wind flow is from left to right. In the flight described earlier in this report, our pilot was flying from right to left and the diagram illustrates the wave-like motion of the flow and the different cloud types he encountered.

The *cap cloud* in the left lower corner of *Fig. 1* hugs the tops of the mountains and flows down the leeward side with the appearance of a waterfall (see also *Fig. 3*). Since it hides the mountains and is connected on the leeside of the peaks, the cap cloud is dangerous. Looking from the valley floor toward the mountain this cloud mass sometimes gives the appearance of a cloud wall, which is responsible for the name "foehnwall," ("Foehn" is the meteorological term for the air current descending from a mountain range) frequently used for this cloud type. The downdrafts can be as strong as 5,000 ft./min. As our pilot discovered, one must have more than the minimum required clearance to traverse such powerful down currents.

Some distance downwind of the cap cloud (lower center of *Fig. 1*) the air shoots up again almost vertically, forming the rotor or *roll cloud*, (*Fig. 4*) with its base at times below the mountain peaks and its top reaching consid-

Fig. 4. Stationary roll cloud in lee of Sierra Nevada. Mountain range, visible in lower right corner, is partly obscured by cap cloud. Strong dust storms over valley floor (lower left corner) blew off hangar roof while gliders were soaring at 34,000 ft. Picture taken from Bishop, Cal., looking west (upwind).

erably above the peaks, sometimes to twice the height of the highest peaks and occasionally to over 30,000 ft. (*Fig. 5*). The rotor cloud may well extend to a height where it merges with the lenticular clouds (*Fig. 6*) to be described in the next paragraph. While often appearing very harmless, the rotor cloud is dangerously turbulent with updrafts of up to 5,000 ft./min. on its leading edge, and equivalent downdrafts on its leeward edge. There is a constant boiling motion in and below this cloud. In overall shape and location, it is effectively a stationary cloud constantly forming on the windward side and dissipating to the lee. There are instances where the roll clouds build up to such a height that precipitation and even thunderstorms form. (So called "wave thunderstorms" form regularly under the mountain wave of the Andes.) Frequently a number of consecutive roll cloud lines extend parallel to the mountain range, each marking a wave crest. The initial roll cloud may be present anywhere from a position immediately to the lee of the mountain peaks to a distance ten miles downwind. In the latter case one might naturally assume that the lift zone ahead of the rotor would be very broad and gradually taper off. This is not true, however, the updraft area can be just as sharply defined as at roll clouds closer to the mountain.

The *lenticular* or lens-shaped clouds (*Fig. 1*, center) which appear in layers sometimes extending to well above 40,000 ft. are relatively smooth. The tiered appearance of these clouds is consistent with the smooth laminar flow in this section of the wave (*Fig. 7*), and is due to the stratified character of the humidity in the atmosphere and to the lifting effect of the wave on the whole depth of the atmosphere which creates condensation in the humid layers. These lenticular clouds, like the rotor, are stationary, constantly forming on the windward side and dissipating to the lee. There might be up to 10 or more consecutive lenticular clouds downwind of the ridge, each marking another lee wave.

At times, severe turbulence is encountered above the extremely smooth lenticulars (see the turbulence band in *Fig. 1* above 40,000 ft.). This is especially true if a typical jet stream combines with the wave in the upper troposphere. The turbulence layers above and below the lenticular levels are comparable to ball bearings, allowing the atmosphere between to flow through at very high speeds.

Occasionally, a breakdown of the laminar flow sets off the formation of severe turbulence throughout the whole depth of the wave. When this happens, the highest lenticular clouds show very jagged, irregular edges rather than the normal, smooth edges (*Fig. 8*). The turbulence near the tropopause then reaches a degree which might cause structural damage to aircraft. The juxtaposition of very

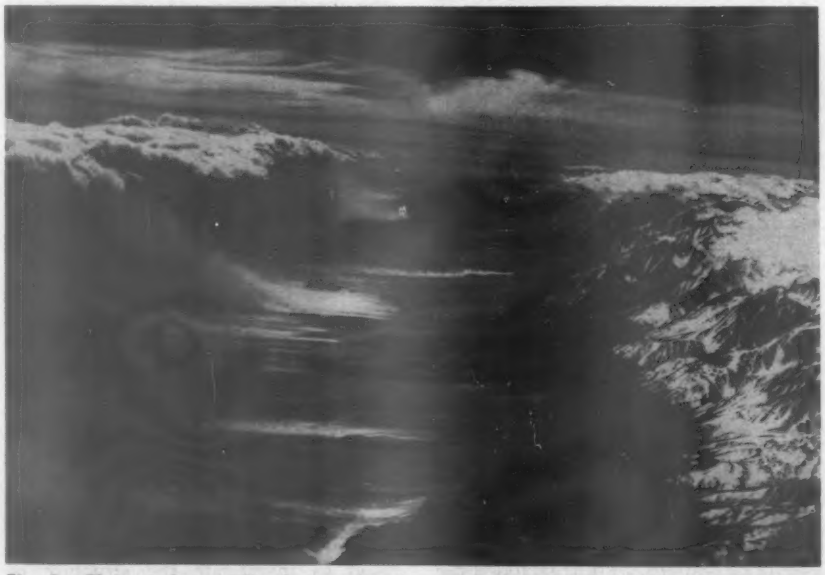


Fig. 5. Picture of unusually strong rotor flow taken from 32,000 ft. over Bishop looking south. Range is to right, with downdrafts striking floor of valley, kicking up dust, and carrying it up into rotor cloud zone. In this case rotor zone is very far back from peaks and cap cloud is partly absent. Dust shows that flow rises directly from ground to over 30,000 ft. P-38 from which picture was taken, climbed in updraft zone from 15,000 to 30,000 ft. with props feathered.

turbulent and very smooth flow, however, is typical in the wave. This was one of the conditions which surprised our pilot.

As indicated in the diagram (*Fig. 1*) the lenticular clouds in most cases tilt toward the mountain range as ascent is made through the layers from the rotor cloud to the highest lenticular layers. As a consequence of this tilting, the streamlines are packed closer together in the downdraft side of the rotor. Thus, the wind speed is considerably increased in the downdraft areas and local jets form which introduce an additional flight hazard by retarding the aircraft in the downdraft.

The mother-of-pearl cloud (upper center, *Fig. 1*) is a rare, highlevel lenticular cloud appearing usually in the polar regions at about 80,000 to 100,000 ft. under wave conditions. This type of cloud is an indication of the enormous vertical extension of a mountain wave. Horizontal dimensions of a wave can likewise be tremendous. In the Sierra Nevada, for example, the wave clouds can extend several hundred miles parallel to the ridge line with a well-defined leading edge following all bends in the mountain range. These clouds are visible from great distances and can provide the pilot with a warning of the existence of wave conditions long before the mountain range is in sight. Our pilot did not have enough knowledge of the wave to recognize this warning.

Fig. 6. Picture taken from glider at 35,000 ft. over Bishop, looking south and showing horizontal and vertical extension of cloud system. Tops of rotor cloud are merging with lowest lenticular clouds. Several lenticular layers can be seen to right of picture. Slopes of Sierra are visible in lower right hand portion of picture and flow is from right to left.

If there are several consecutive wave crests, the amplitude and intensity of the waves decrease as you go downstream. The distance of the first wave crest from the mountain peaks varies with height and depends on the wind speed, the type of wind profile, and the lapse rate. So does the wavelength (between crests) which is of the order of 5 to 10 miles, occasionally more or less. In levels over 30,000 ft. the leading edge of the wave cloud is generally directly over the summits; in low levels, a few miles downwind.

While the overall context of the cloud formation is stationary over a considerable period of time, the clouds can change position, shape, and structure in an extremely short time, and there is continuously a considerable amount of motion in and around the clouds. Extensive clouds can form or dissipate in a matter of minutes.

Any mountain range with crests of 300 ft. or higher can produce a wave. Over low mountains, the wave effect has been observed up to a height twenty-five times that of the range but the roll cloud is sometimes missing. The intensity of the wave is, in part, a function of the mountain height and the degree of slope of the mountain range as well as the strength of the flow, all three contributing positively to the wave intensity.

Fig. 7. Heavy lenticular layers blanketing sky. Smooth texture and well-defined edges of clouds indicate laminar motion. Wind is from right to left.

The Invisible Mountain Wave

There may be times when meteorological conditions are favorable for the creation of a mountain wave, but the lack of moisture in the atmosphere prevents the formation of clouds. This cloudless or "dry" wave is rare but can approach the waves previously discussed in turbulence. It can be dangerous even to pilots experienced in mountain wave flying, since it lacks the warning features that the recognizable clouds in most waves will provide.

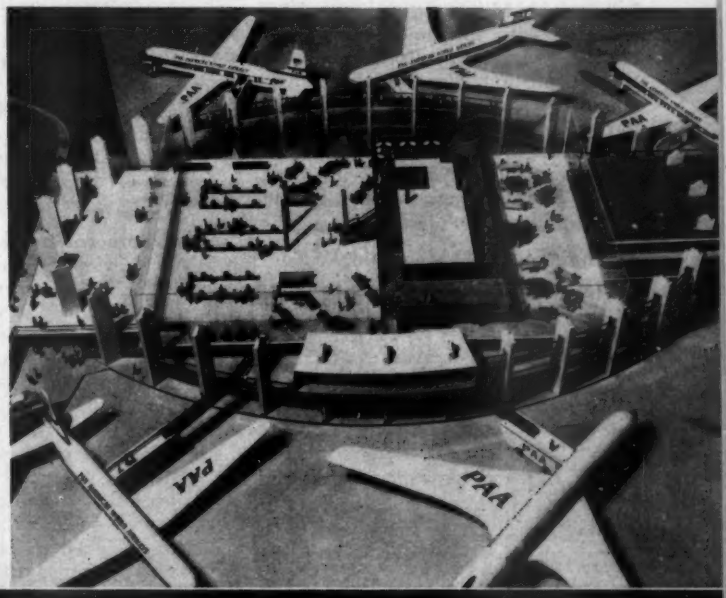
IFALPA Conference

The 12th Conference of the International Federation of Air Line Pilots Associations held in Athens, Greece, last March, was attended by 41 representatives of 27 pilot organizations from 25 nations. Shown above at head table, l. to r.: D. Follows, Secretary; ALPA President C. N. Sayen, re-elected to the IFALPA presidency for the fifth time; C. C. Jackson, Technical Secretary. On left: Pres. Sayen addressing Conference dinner. Below: L. to r.: P. E. Bressey, BALPA, IFALPA First Vice President; ALPA's Reg. I V.P. C. C. Spencer (PAA), Treasurer D. J. Smith (TWA), Secretary R. L. Tuxbury (UAL), who made up ALPA's delegation.

Slick MEC

The first meeting of the Slick Airways MEC was held at the Home Office in late June. This body represented the cargo carrier's 200 pilots who recently joined the Association. ALPA now has 52 member air lines.

The ALPA Camera



New PAA Terminal

Scale model of new $8 million three-story air conditioned PAA terminal at IDL, slated for completion late next year. Picture below shows how passengers will unload on second floor level to proceed under cover of cantilevered roof, extending 110 ft. out over aircraft parking area, to planes. On right: Model with roof removed shows lounges next to gate positions. Terminal design, based on Berlin's Tempelhof airport construction, allows aircraft to be brought direct to passengers.

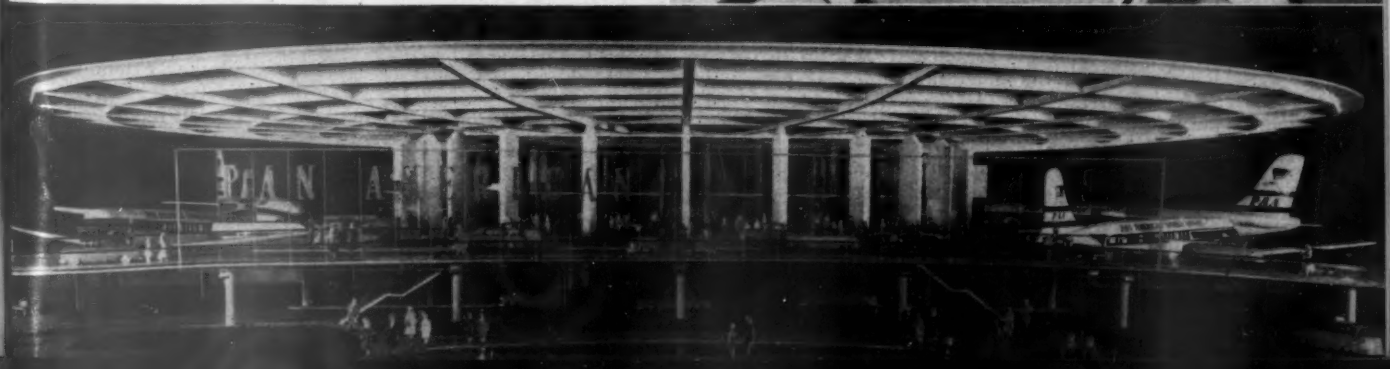


Fig. 8. Extreme turbulence at high levels between 32,000 and 42,000 ft. High lenticulars show very rough edges. Fragments of clouds move rapidly across wave showing large vortex elements. Wind is from right to left.

Most serious is the case where the wave flow is completely obscured by a thick overcast with low ceiling. The wave is present and might be powerful but it is hidden to the pilot who is occupied with instrument flying. Additional hazards are present in the form of precipitation and icing. In the opinion of the authors it is practically impossible to penetrate the lower parts of a strong rotor cloud in controlled instrument flight. The majority of accidents in the mountain wave has occurred under these conditions.

What Forms A Mountain Wave

The phenomenon of the mountain wave is essentially the same as the flow of water over a barrier which forms rapids and waves downstream. However, the fact that the atmosphere is a gas and that temperature, humidity and winds are changing with height, introduces considerable modifications. In the air-flow model described in *Fig. 1,* the troposphere consists of two layers. They are separated by a temperature inversion on top of the cap cloud. Consequently, at least two processes work simultaneously:

a) A "spill-over" of the lower layer which shoots down the mountain slope with increasing speed after passing the crestline, at the same time sweeping away pockets of old stagnated air in the valley. It then jumps up into the rotor clouds in a manner related to the hydraulic jump of water.

b) An internal lee wave in the upper layer which forms in the wake of the mountain barrier and over the rotor zone.

The interaction of these two effects probably determines the height and position (with respect to the mountain) of the rotor cloud, as well as the amplitudes of the waves. Complications are introduced by the change of winds with height, and further, by the existence of the stratosphere, basically a third atmospheric layer.

Meteorological Conditions

As previously stated, a favorable condition for the formation of a wave is for the wind at the mountain-top level to flow perpendicular to the mountain range. Actually, the wind direction can vary somewhat (50° being the maximum deviation from the perpendicular) and still cause a wave, but the most intensive waves occur with a strong perpendicular flow. The stronger the flow, the more severe are the effects to be expected on the leeward side. There is a minimum of waves in summer and a maximum in winter. During the latter season, for example, over a range like the Sierra Nevada, waves can be expected during one out of four days with two or three strong waves per month included.

In the western United States where these waves have been frequently observed, it has been noticed that the strongest ones develop when there is a cold front approaching the mountains from the northwest and a trough aloft approaching from the west. This produces a strong westerly flow over the mountain ranges which have a north-south orientation.

In accordance with the two-layer model of *Fig. 1,* there is generally a stable layer or temperature inversion present on the windward side of the range up to an altitude slightly above the peaks. A pre-frontal area usually includes this condition. The top of this stable layer is just above the cap cloud and dips to its lowest level at a point directly over the downward foot of the mountain. In the valley the winds are frequently parallel to the mountains or even reversed. Without this stable layer, convective instability would tend to break up the wave pattern.

The most favorable wind profile for the existence of a high wave has winds exceeding 25 knots at the mountain top level. There is usually a rapid increase in the wind speed with altitude in the level of the mountain range and for several thousand feet above with a strong, more uniform, flow up to the tropopause or higher. The character of the wave varies with different wind profiles. An exceptionally strong increase of wind with height (perhaps from 40 knots at mountain top to 100 knots 5000 ft higher) can eliminate the wave, leaving only stagnant air in the valley. A strong wave frequently is associated with the jet stream, the zone of strongest wind flow, when the latter is located in the neighborhood of the range. The strength of the flow during such a strong wave may be from 75 to 150 knots in the upper troposphere. In this case one has to watch out for high level turbulence.

The same type of wave pattern as found in the Sierra Nevada has been observed all over the world. In fact, sailplane pilots have made use of these waves as an aid in soaring on all continents for years.

The following is a summary of the meteorological criteria which could serve to alert a pilot to the probability of a mountain wave:

a) Wind flow perpendicular to the range line and with a speed of more than 25 knots at mountain top level.

b) A wind profile which shows a strong consistent flow extending several thousand feet above the mountain tops, or an increase in speed with altitude.

c) An inversion or stable layer somewhere between the mountain tops and the 600 millibar level.

(Continued on Page 18)

Standards For Turbine Transports

The CAA Is Now Faced With Applying Airworthiness Standards To Turbine Transports. An ALPA Safety Forum Report On The Process And Program By Which This Is Being Done

By Harold Hoekstra
CAA

We in the CAA have been working for some years on the problem of airworthiness of turbine transport aircraft. Almost ten years ago, we began our first studies on the development of standards for these aircraft. As our studies progressed, we published the "Yellow Book" and the "Green Book." In addition, the Prototype Law of 1950 provided additional incentive for study and an increasing amount of pilot training, maintenance work and special engineering studies, using available military and aircraft manufacturing facilities.

However, we are now faced with actually applying airworthiness standards to turbine-powered transports. Several months ago, the number of applications for certification of turbine engines became greater than those for reciprocating types. Applications are now on file for six jet transports, four executive jets, nine turboprop transports and six turbine-powered helicopters. Of these, 14 are U. S. and 12 are of foreign manufacture. The first of these transports, the Britannia, is scheduled to be certificated this year.

With this brief summary, let us look at the approval basis and process. The present Civil Air Regulations, which have been developed over a period of years, cover reciprocating engine aircraft and have done much to establish the outstanding safety record of American aircraft. They do not, however, cover many of the aspects introduced by turbine power. Good progress is being made through the annual review process and special spot changes to bring the Civil Air Regulations up to date for turbines. However, such a process must necessarily lag behind developments in this tremendously important and rapidly developing field. Hence, the CAA has followed the policy of studying new designs with the manufacturer as they develop. This permits the CAA to develop special conditions to be added to the currently applicable Civil Air Regulations to maintain the present level of safety. Later, these will become the basis for regulations. The CAA has developed certain additional special conditions, therefore, for all of the turbine transport aircraft for which application for approval has been made.

With this background of the coming aircraft and the overall method of approving them, let us look at some of the specific problems now being studied and solved.

Performance

We in the CAA believe that new turbine performance requirements should correct known deficiencies or excessive conservatisms in the present requirements and should be related to past experience in a manner that will assure that the turbine transport overall safety record can be expected to be equal to or better than the present record. We also believe that any new regulations should be based on technical logic and fact. Therefore, we have concluded that a uniform level of performance should be specified, considering all variables which can be accounted for, from a technical and practical standpoint.

Flight Characteristics

The usual problems of handling qualities and control forces in the jets probably will not change greatly compared with past aircraft. Stalling characteristics may even improve with these new types because of increased knowledge of the stalling phenomena. One of the important problems which turbines have brought into the picture is that of speed pickup and speed ratios. Here, the nature of the jet, particularly higher speed and its lower drag characteristics have focused attention on the problem of slowdown when encountering turbulence and weather. This weather requirement, together with possible emergency conditions requiring rapid descent, dictate the necessity of the aircraft being able to descend from high cruising altitudes in a minimum of time. This may be accomplished through spoilers, dive flaps, or, in the case of turboprop aircraft, possibly propeller drag.

Courtesy: De Havilland Gazette

"This is the standard cabin layout, but of course it can be modified to customers' requirements."

UAL's "Rube" Wagner, Veteran ALPA Member, Retires

On August 1, 1957, one of the oldest members of the Air Line Pilots Association, and a veteran of almost forty years of flying retired as Captain of United Air Lines. He is Capt. R. L. "Rube" Wagner, who holds ALPA Membership No. 13

Wagner, born on July 7, 1897, in Fairbury, Nebraska, attended Nebraska State University before enlisting in the Aviation Section of the Army Signal Corps in 1918. After leaving the Army, he spent 1920-1923 barnstorming on the State and County Fair circuit in the Midwest, using World War I Curtis JN-4Ds (Jennies).

Air Mail Pioneer

In 1923, he became one of the nation's air mail pioneers. On August 21, 1923, Wagner helped make history by flying the CLE-CHI leg of the first transcontinental air mail trip.

When Boeing Transport began flying air mail in 1927, Capt. Wagner joined that company, a predecessor of United Air Lines, and flew between SFO and CHI. He was appointed Superintendent of Flying in

Capt. R. L. Wagner

December, 1935, and held this assignment through November, 1938.

During World War II he was assigned to United Air Lines' military contract operations for the Air Transport Command, flying between San Francisco and islands in the Pacific.

On Honolulu Run

When United began its scheduled operations to Honolulu ten years ago, Wagner was one of the first pilots assigned to the run — an assignment he held until his retirement.

The number one pilot of United's seniority list, he has nearly 32,000 hours in his flight log. He also possesses an enviable safety record in that in his entire career of flying he has never scratched an airplane.

Asked whether he has collected scrapbooks of newspaper clippings and photos of his part in the development of aviation, Wagner stated, "No, I have not saved a thing. I think it is wrong to look backwards — I like to look ahead at what the future is going to bring in the aviation industry."

His greatest feeling of achievement during a long and colorful career, he said, was piloting the first mail plane into several Midwest cities when air mail service was inaugurated there.

Wagner lives at 70 Serrano Drive, Atherton, California, a suburb of San Francisco.

Another phase that must be explored carefully and thoroughly is the need for a full operational range of speed load and altitude, which is free of buffeting. Buffeting, of course, is associated with flow breakdown at the higher mach numbers.

Cockpit

Considerable work has been done through government-industry effort, in the Society of Automotive Engineers and others, to improve cockpit visibility for the pilot. Angles down and up and laterally, both in normal flight and turning flight, are being specified to produce aircraft with improved visibility. There is no question but that this is greatly needed. However, a larger windshield brings other problems such as loads due to pressurization, more difficulty in providing protection against bird impact and also finding adequate room in the cockpit for proper placement of necessary instruments, controls and lights.

The location and method of presentation in instruments has been the subject of considerable study and variation in opinions. Here, the CAA's interest is directed toward a sound and logical location of the primary instrument group, without attempting to standardize the many other instruments and controls.

The contentious problem of landing gear lever location has, we hope, been satisfactorily resolved by specifying its position forward of the throttles available to both pilots with an up and down notice and a wheel type knob on the handle. The need to locate left or right of the center of the panel has been removed. Further, as a step in removing the past confusion in the use of landing gear and flap controls, the flap control must be at least ten inches aft of the landing gear handle and preferably to the right.

Power Plants

Despite millions of hours of operation of straight jet engines in military service, and a substantial amount of turboprop military service, study of these power plants for civil operation is bringing about a number of changes. Because of the damage that could result from blade failure, whether in the compressor or turbine portions of the engine, it will be necessary to provide casings which will contain the blade fragments. Further, either the turbine wheels themselves must be shown by exhaustive test and analysis to be free from failure, as it will be necessary that the airframe itself be protected so that failure will not jeopardize the continued safe flight of the aircraft. Pumps, filters and aircraft systems are receiving increasingly critical study and there is no question that the instrumentation concerning RPM and jet pipe temperatures must be accurate and readily readable.

One matter which has been the subject of considerable discussion is that of protection against fuel spillage in accidents. The location of the tanks, the construction of the lower surface and the attachment of landing gear are all factors. The standard for the tank itself will be that there be no spillage in a wheels-up landing on a relatively level surface, such as a runway, under the crash conditions specified for the cabin itself.

Intensive study is under way on fire protection of turbine engine installations. The CAA Technical Department Center at Indianapolis is, at this time, completing the setup to test a typical

(Continued on Page 18)

FLYER'S FORUM

Flashing Vs. Steady Position Lights

The Best System Available Today Is Not The "Flying Christmas Tree," But One Displaying Steadily-Burning Position And High-Intensity Anti-Collision Lights

By Capt. R. A. Stone, UAL

Chairman, ALPA Aircraft Exterior Lighting Committee

The Charles Adler, Jr. Safety Foundation has issued a *Technical Bulletin,* dated March 1957 devoted exclusively to the subject *Steady vs. Flashing Aircraft Lights.* The bulletin asserts that adoption of steady-burning position lights instead of flashing lights is a backward step in the protection against mid-air collision.

This bulletin will probably generate much discussion since Mr. Adler has been interested in aircraft lighting for many years and is the inventor and patent holder of flashing position lights.

'Steady' Found Effective

Flashing position lights were a very significant improvement over steady lights years ago when position lights were the total lighting system installed on aircraft and Mr. Adler deserves the deep gratitude of the aviation industry for developing these improved lights. Today, however, when airplanes are equipped with high intensity anti-collision lights, the situation changes and position lights have been found to be much more effective when on "steady" rather than "flashing." This decision was not arrived at hastily, but resulted from careful evaluation of several flight tests which were conducted specifically to resolve the question of whether position lights should flash or burn steadily on aircraft equipped with a high intensity anti-collision light.

Also, to broaden the scope of the evaluation, some airlines flew airplanes with an anti-collision light and steady-burning position lights and solicited comments from pilots and control tower personnel. After analyzing the results of these various test programs it became evident that the preferable lighting system should employ:

- The high intensity anti-collision light to make the airplane conspicuous, and
- The steady-burning position lights to define the flight path of the airplane.

The Air Line Pilots Association has actively advocated use of this lighting system and last year the Air Transport Association also endorsed the system; recently the Civil Air Regulations were amended to permit display of this lighting system on all air carrier airplanes.

A 'Flying Christmas Tree'

An important collaborating factor, which also influenced the decision in favor of steady-burning position lights, was the strong objection many pilots voiced against the "flying Christmas tree" display that had come into being: flashing wing tip lights, flashing lights on top of the fuselage, flashing lights on the bottom of the fuselage, alternating red and white flashing tail lights, and a flashing high intensity anti-collision light. The airplane had been made conspicuous, but unfortunately it was next to impossible to determine its flight path from this conglomeration of flashing lights and after all, evasive action cannot be initiated until first the flight path of the intruding airplane is determined.

The Adler bulletin presents various arguments in favor of flashing position lights, but many other lighting specialists take definite exception to those arguments. For example, Adler maintains that flashing position lights give more protection than an anti-collision light when the airplane is climbing or descending. The point that is not recognized here, is that when airplanes are climbing or descending their nose-up or nose-down angle is extremely small. When an airplane changes from level flight to either a climb or descent, the nose moves up or down just a very few degrees and the actual flight trajectory is very nearly horizontal. Consider the case of an airplane making a 1,000 feet per minute descent at 300 miles per hour airspeed; this means a 1,000 feet descent accomplished in 27,400 feet of forward travel, or in other words, the flight path is only 2 degrees down from horizontal. High intensity anti-collision lights have a vertical beam spread of 20 degrees above and 20 degrees below the plane of flight and therefore adequately cover flight paths both in climb or descent as well as in level flight.

Value Of Anti-Collision Lights

Anti-collision lights not only provide coverage above and below the flight path, but they do it much more effectively than flashing position lights simply because anti-collision lights are high intensity lights. The position lights produce only 40 candlepower, while in contrast, the anti-collision light produces 4,400 candlepower. Furthermore, the position lights are visible only in restricted segments but the anti-collision light sweeps the entire 360 degrees surrounding the airplane.

Whether two airplanes are converging in level flight or in any normal climb or descent, be it either head-on, overtaking, or closing from the side, the high intensity anti-collision light will be visible, and much more conspicuous, than the low powered flashing position lights. There is one special case of aircraft convergence in which no lighting system can be the least bit effective; this is the case of two airplanes flying in the same direction at the same speed and converging vertically with no relative horizontal movement. In this particular case one airplane is hidden by the cockpit floor and the other is hidden by the cockpit roof; thus far no lighting system has been developed which can penetrate aluminum.

Candle Power Factor

The real crux of much of this discussion is candlepower. Position lights are low powered and anti-collision lights are high powered. A further factor which works against the effectiveness of flashing position lights for making aircraft conspicuous is the fact that a flashing light does not produce its full rated candlepower. Measurable time is required for the filament of a flashing position light to heat to incandescence each time electricity is applied to the lamp and therefore either the filament does not attain its full rated candlepower before the flasher unit disconnects the electricity or the duration of rated candlepower is very short. The human eye does not react too well to short flashes of light unless they are very bright and consequently the pilot does not "see" a weak flashing light as well as he "sees" the same

Pioneer Airmen Reunion At Kansas City

The National OX5 Club, fraternity of pioneer aviators, will hold its second annual reunion at Kansas City, Sept. 7. This flying group, which grew from two men to nearly 4,000 within a two-year period, is made up of the men and women who have made aviation history, since World War I.

The Club, according to National President Russ Brinkley of Harrisburg, Pa., takes its name from the water-cooled, 8-cylinder engine which powered the first army Jenny training planes in the first World War. Most of the nation's early flyers won their wings in planes powered by the 90-horsepower OX5, which became known as the Model T of the airways.

Age limit of current members ranges from 40 to 85 years with the eldest member being Henry Kleckler, 85, of Bath, N. Y. Kleckler joined Glen Curtiss in early aviation experiments on Jan. 1, 1907 and later designed and perfected the engine which gives the club its name.

The highlight of the 1957 convention will be the election of three new national Governors and the naming of Mr. OX5 for 1956.

light when it is steady-burning. The "on" period of flashing position lights is approximately ⅜ second, which has been proven to result in the light having an effective brightness only 65 per cent of what the same lamp would produce if steady-burning.

The anti-collision lights overcome these technical and physiological objections by utilizing high candlepower, a continuously illuminated filament, and a longer flash duration. All of these factors combine to make the effective brightness of a modern anti-collision light many times that of a flashing position light.

The basic thinking behind steady-burning position lights is that the aircraft has been made conspicuous by the high intensity anti-collision light far more effectively than it could be by low powered flashing position lights and it has been conclusively demonstrated that steady-burning position lights define the flight path better than flashing position lights. By burning the position lights steady the filament is continuously incandescent at full rated candlepower and also steady-burning position lights cater to the human eye's ability to see a steady weak light better than a flashing weak light; the effective brightness of steady-burning position lights is approximately twice as great as compared to the same position lights if they are flashing.

Location Of Lights

The Adler bulletin mentions in detail the case of two airplanes converging on almost parallel courses and claims that the forward location of flashing position lights on the wing tips is more conspicuous than the aft location of the anti-collision light. In reality the locations of any of these lights on an airplane are so close together that, at any reasonable distance away from the airplane, any light on the airplane is essentially being emitted from one single point in space. The high intensity anti-collision light, even though it is mounted a few feet aft of the low powered wing tip lights, is much more effective and conspicuous under all conditions of normal flight regardless if the wing tip lights are flashing or steady-burning.

The Adler bulletin expresses concern for an airplane circling an airport for landing and the pilot not being able to see the anti-collision lights on airplanes at lower altitudes preceding him in the traffic pattern. Recollect that the anti-collision light has a vertical beam spread 20 degrees above the horizon; this means that the following airplane would have to be diving at an angle in excess of 20 degrees before it could approach the preceding airplane in an area where the anti-collision light would not be visible. Airplanes in a landing traffic pattern do not converge on each other at such extreme angles; if the second airplane is more than 20 degrees above the first airplane it cannot collide with the first airplane unless an extreme dive is made. (Once again there is the exceptional case of vertical closure with no relative horizontal motion; no lighting system can protect against this hazard because the aircraft structure itself creates blind spots directly above and below the cockpit).

The Adler bulletin accuses the high intensity anti-collision light of being so bright that it obscures the low powered position lights. This is true at long range but as the airplanes approach each other it will be the steady-burning position lights, which will be discernible sooner than flashing position lights because of the loss of effective brightness suffered by the flashing lights due to alternately heating and cooling the filament and also due to the poorer reaction of the human eye to flashing lights. This simply means that the steady-burning position lights, having approximately twice the effective brightness as the same lights when flashed, will be seen sooner and will permit quicker determination of the flight path of the intruder and commencement of evasive action.

Visual Hazards

The Adler bulletin speaks of "autohypnosis" caused by a pilot observing a steady light and "autokinesis," which causes the pilot to believe a steady light is moving when actually it is stationary. These phenomena are definite hazards if aircraft display only steady-burning position lights with no anti-collision light, but the hazard disappears if the lighting system includes a flashing anti-collision light. The high intensity anti-collision light is flashing brilliantly and does not produce autohypnosis nor autokinesis. The pilot is kept alertly aware of he presence and position of an intruding aircraft by the flashing anti-collision light and he uses the steady-burning position lights as supplementary aids to determine the intruder's flight path. This is the modern lighting system and it eliminates the utter confusion which formerly resulted from viewing the "flying Christmas tree" where every light on the airplane was flashing: white lights appeared either on top of the airplane or on the bottom or on the tail; red lights appeared on the tail sometimes and on the left wing tip sometimes. The new Civil Air Regulation now permits a simple and clearly understandable display of lights: green on the right, red on the left, and white on the tail. Each color has its own segment and confusion is gone.

The lighting system, which uses a high intensity anti-collision light to make the airplane conspicuous and then uses steady-burning position lights to define its flight path, is not a backward step as charged by Mr. Adler; it represents the best lighting system available today. This does not mean that further improvement of aircraft lighting is not needed and undoubtedly better systems will be developed in the future, but at this stage the best system displays steady-burning position lights and a high intensity anti-collision light.

Operational Report On "Golden Triangle"

First Experience Affirming The Validity Of Premises Upon Which Procedures Were Based

By T. A. Basnight

ALPA Engineering & Air Safety Dept.

The Fourteenth Convention adopted several resolutions designed to improve safety and service in air commerce. It also authorized President Sayen to appoint a committee to study Air Traffic Control capabilities and to formulate a program for gradual transition to full IFR. It was stipulated that the Board of Directors would approve each step prior to implementation.

The committee appointed includes: J. D. Smith, Chairman; R. L. Tuxbury, Sam Saint, Jim Elrod and the author, the latter assigned as staff coordinator.

After surveying numerous approaches to the problem, the Committee recommended that the "Golden Triangle" procedures be effected July 1, 1957. This procedure was authorized by ballot of the Board of Directors.

In view of the fact that some of the Committee members felt that air line management would be interested in supporting the program, meetings were held with the ATA VFR Committee (this ATA committee has representation from several air lines).

Accepted By ATA

The program was accepted by the ATA committee and discussions were held with the CAA and the CAB. While there was some reservation expressed as to the program's feasibility, ALPA's position remained the same—that within the Triangle, radar equipment and direct communications, as well as controller experience, was such that the plan could not only be successful but improve safety while exploiting the heretofore unknown capabilities of the system.

Aspects Of Implementation

With only a short period of experience, under the procedures, several important aspects of the implementation have been brought out:

▶ The plan has caused no extensive delays or flight cancellations.

▶ Controllers have cooperated even though increases in flight postings on VFR days have occurred in some instances. This is especially encouraging, in considering the controllers, since these increases have been as much as 50 per cent over previous VFR days in some sectors.

▶ Controllers have had an opportunity to increase on-job training in the handling of IFR flying. (This will probably be reflected in a much smoother handling of IFR traffic in the coming winter months.)

▶ Pilots have been more conversant with the routine minor problems facing traffic control and have offered more assistance to the controllers—such as relaying of transmissions which the controllers have not received and the volunteering of positions and altitude information which they heretofore awaited the controllers to request.

▶ Pilots have found that by exercising the use of "On Top Flying" judiciously to circumnavigate turbulence, etc., while leaving their IFR flight plan in effect, have by and large made up for flexibility usually associated with VFR climb and descent.

Industry-Wide Cooperation

It is significant that although the decision to implement the "Golden Triangle" was made by the professional pilots of ALPA, all segments of the industry and government have willingly assisted in making this program, which makes such a bold step forward, one of the most successful air traffic control programs which ALPA has ever initiated. It reaffirms the fact that the professional pilot's evaluation and action in all phases of air commerce is a vital requirement to the progress of one of the world's largest, most significant industries.

"Briefcase Brains" . . .

(Continued from Page 3)

It must be remembered there are only three rules which are paramount in an air line operation. These are: safety, passenger comfort, and schedule. If they are observed religiously there can be little to object to in the flight, even if some of the rules are bent a little at times, or even if the odd one is ignored, just as long as what was done was well considered and in good judgment. A Captain exists to command and the discretionary rights of a commander are basic to his function. A pilot cannot fulfill this function if fear of criticism, laziness, humility or such other reasons as there are prohibit him from exercising his rights as needed, using his own common sense and good judgment.

"Monkeyshines" In The Cockpit

The following dispatch went out over the United Press wires recently and is reprinted here without comment:

Kansas City, Mo., May 31—(UP)—A chimpanzee invaded the co-pilot's chair on a cargo flight from Detroit to Kansas City yesterday.

Walter Miller, Dallas, Tex., pilot for Slick Airways, said the animal was "friendly, but no help." It had given him and two other crew members, Wallace Keck, Wellsgorough, Pa., and William Wohlschlegel, New Brunswick, N. J., a thorough shellacking in an impromptu game of keep-away.

Miller said the chimp, bound from Philadelphia to a pet shop in Santa Cruz, Calif., broke out of its crate when the DC6-A plane was about 20 minutes out of Detroit.

She revealed her escape by a sudden attempt to share the seat occupied by Keck, flight engineer. With Wohlschlegel's aid, Keck launched an effort to snare her.

The ape, Miller said, apparently regarded the whole business as a delightful game.

In the course of it she used the plane's radio racks as a trapeze, consumed the crew's supply of instant coffee and powdered cream, and ultimately slipped into Wohlschlegel's place beside the pilot.

The co-pilot chased her out and the effort to corral the chimpanzee was abandoned.

When the plane landed here the chimp was enthroned on a radio rack, surveying the operation. Six men succeeded in caging her, but they took 20 minutes to accomplish it.

Hazards Of The Mountain Wave . . .

(Continued from Page 12)

The Hazards Of The Wave

The most dangerous feature of the wave is the combination of downdrafts, jet-like winds, horizontal turbulence and altimeter errors. These dangers cannot be stressed too highly. Pilots, even those with considerable experience, should avoid direct flights upwind through a full scale mountain wave, either by circumnavigating the area, delaying the flight, or flying at extremely high altitudes.

The downdrafts to the lee of the rotor, and the updrafts below it can carry a plane into the rotor cloud while a pilot is attempting to pass above or below this cloud. The best procedures for one caught in the rotor cloud is to nose down to pick up speed and attempt to reach the updraft area in advance (upwind) of the rotor to regain altitude. If the aircraft approaches the crestline of the mountains from the downwind side with insufficient height it will be practically impossible to climb through the jet-like currents near the mountain slope. These conditions, plus the fact that the peaks are hidden most of the time by the cap cloud, make it very likely that a plane fighting strong headwinds at minimum clearance altitude would fly into the mountain peaks.

As the barometric pressure is considerably disturbed in the mountain wave, altimeter errors are associated with the wave conditions. Since the wave is mostly a winter phenomenon, the temperature error in the altimeter reading frequently neglected by pilots contributes to an overestimation of the flight altitude. The maximum total error possible has been estimated to be about 1,000 ft. However, altimeter errors as high as 2,500 ft near the mountain peaks have been claimed by pilots although this seems an extreme figure. Data are not yet evaluated to prove or disprove these figures. At a certain level the maximal positive "altimeter error," indicating greater than actual altitude, can coincide with the downdraft area immediately to the lee of the mountain range, leading to very hazardous conditions. Under wave conditions pilots should not place too much confidence in their altimeter readings.

Pilots, who have the greatest experience in both soaring and flying under wave conditions, relate that they consistently lost all control for short periods while under the influence of the roll cloud. They report they have experienced more hazardous flight conditions in the wave then they have encountered in any thunderstorms. In fact, effective gust velocities measured in the sailplanes at heights up to 40,000 ft. were of the order of 40 ft./sec. This is more than has been measured in the extensive Air Force-Weather Bureau Thunderstorm Project. In wave flight, full controls have to be used to maintain a heading.

Although vertical displacements of aircraft flying downwind through the wave are generally moderate, the turbulence effects may be worse. Estimates show that high speed aircraft (jet class) flying downwind through the rotor zone would experience accelerations which can be structurally dangerous.

RULES FOR FLYING THE WAVE

The following rules of flight are suggested to pilots for flights over mountain ranges when wave conditions exist:

- If possible, fly around the area when wave conditions are indicated. If this is not feasible, fly at a level which is at least 50 per cent higher than the height of the mountain range.
- Do not fly high speed aircraft into the wave; particularly, do not fly downwind. Structural damage may result.
- Avoid the rotor (roll) cloud.
- Avoid the cap cloud (foehnwall) area with its strong downdrafts.
- Avoid high lenticular clouds if the edges are very ragged and irregular, particularly if flying high.
- If flying against the wind, updraft areas, especially the one upwind of the rotor clouds, may be used as an aid in gaining the altitude necessary to pass through the downdraft areas and cross the mountain range.
- Do not place too much confidence in pressure altimeter reading near the mountain peaks.
- Avoid penetrating a strong mountain wave on instrument flight.

Turbine Transports . . .

(Continued from Page 14)

J-57 engine pod to determine best detector locations, fire extinguisher locations and extinguishing quantities.

Airframe And Equipment

One of the most important problems in this area is that of structural fatigue. With the tremendous initial cost of a large jet aircraft, it is obvious that it should remain in service for a large number of hours. Very careful attention is being paid by the designers and by CAA to this problem. The approach being employed in the Civil Air Regulations is that significant parts of the airplane's primary flight, important structure be either "fail-safe" or that a safe fatigue life be established. Generally, all manufacturers are working toward the "fail-safe" basis where possible. This means that any fatigue failure of a single principal structural element will not be catastrophic with respect to the aircraft.

We require evidence that catastrophic failure or excessive structural deformation which could endanger the safe flight of the airplane, will not occur after fatigue failure or after partial failure of a principal structural element. To achieve this, residual strength load levels which the damaged struc-

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ture must be able to withstand, have been specified in the requirements.

The emergency exit problem has received considerable attention because of the trend to increasing numbers of passengers and larger amounts of fuel carried aboard. It is imperative that all possible precautions be taken to allow emergency egress in as brief a time as possible. As a part of this study, a helpful meeting was held between the CAA, CAB, a number of West Coast aircraft manufacturers, AIA, ATA, ALPA and others, to resolve certain emergency exit problems causing difficulties in fuselage design. At this meeting, it was possible to work out alternative means of providing adequate exit facilities. One aspect of the problem is, of course, the main door. With respect to the larger jet transports, at least, considerable mechanical ingenuity is being exercised in the development of main doors which are "plug-type" insofar as pressure loads are concerned. These doors, after moving slightly inward, proceed to swing outward for ready passenger use.

Another important problem now under active study in the operation of turbine transports, is establishing the spread between normal operating speeds and design limit speeds. We must preclude the probability of exceeding design limits during normal operations. The problem becomes acute for turbine transports because the arbitrary speed spreads used in the past for piston-powered aircraft are believed to be economically untenable for these newer types.

A Note Of Thanks

Gentlemen:

I wish to thank each and everyone who has been so kind to Sally and myself during the past few weeks. There are not enough words to do it adequately.

Horton would be proud if he could know what wonderful cooperation we got.

Each pilot, as well as the management of T.W.A. put forth special effort to do their utmost for us.

We sincerely thank everyone.

Very truly,
Mrs. Horton Hale

(Editor's Note—Capt. Hale died on June 15, 1957, while at the controls of a TWA Constellation. He was 52 years of age.)

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